

**WHAT IS CLAIMED IS:**

1. A cooling apparatus for use with an optical element having a concave part, said cooling apparatus  
5 comprising a cooling mechanism, located in the concave part of the optical element, for cooling the optical element through radiation in a non-contact manner.

2. An optical element comprising:  
10 a base having a surface to be illuminated by light, and a first concave part; and  
a cooling mechanism, located in the first concave part, for cooling said base through radiation in a non-contact manner.

15

3. An optical element according to claim 2, wherein the surface has an area to be illuminated, and the first concave part is located opposite to the area on the surface.

20

4. An optical element according to claim 2, wherein said cooling mechanism includes:  
a radiation plate provided opposite to the base; and  
25 a Peltier element that cools the radiation plate.

5. An optical element according to claim 4,  
wherein said cooling mechanism has a channel for  
coolant to flow, and further includes a cooling jacket  
for recovering heat from the Peltier element.

5

6. An optical element according to claim 2,  
wherein said cooling mechanism further includes a heat  
insulator for preventing the base from absorbing heat  
obtained by the first concave part.

10

7. An optical element according to claim 2,  
wherein the base has a second concave part provided at  
a position different from that of the first concave  
part in a non-illuminated area.

15

8. An optical element according to claim 7,  
wherein the second concave part is opposite to the non-  
illuminated area on the surface to be illuminated.

20

9. An optical element according to claim 3,  
wherein an interval between the area to be illuminated  
and the first concave part is made almost constant.

25

10. An optical element according to claim 3,  
wherein the first concave part has a shape that changes  
according to temperature distributions on the surface  
to be illuminated.

11. An optical element according to claim 3,  
wherein the cooling mechanism changes cooling power  
based on a position according to temperature  
distributions on the surface to be illuminated.

5

12. An optical element according to claim 2,  
further comprising a mirror.

13. An optical element according to claim 2,  
10 further comprising:  
a detector for detecting a temperature of  
said base; and  
a controller for controlling said cooling  
mechanism so that the temperature of said base detected  
15 by said detector becomes a predetermined value.

14. An optical element comprising a surface to be  
illuminated by light, said optical element having a  
concave part opposite to the surface.

20

15. An exposure apparatus comprising an optical  
system for exposing a pattern formed on a mask or a  
reticle onto an object, wherein said optical system  
includes an optical element, and the optical element  
25 includes a base having a surface to be illuminated by  
light, and a first concave part, and a cooling  
mechanism, located in the first concave part, for

cooling said base through radiation in a non-contact manner.

16. An exposure apparatus comprising an optical  
5 system for exposing a pattern formed on a mask or a reticle onto an object, wherein said optical system includes an optical element, and the optical element has a surface to be illuminated by light, and a concave part opposite to the surface.

10

17. A device fabricating method comprising the steps of:

exposing a pattern on a mask or a reticle  
onto an object using an exposure apparatus that  
15 includes an optical system, wherein said optical system includes an optical element, and the optical element includes a base having a surface to be illuminated by light, and a first concave part, and a cooling mechanism, located in the first concave part, for  
20 cooling said base through radiation in a non-contact manner; and

developing the exposed object.

18. A device fabricating method comprising the  
25 steps of:

exposing a pattern on a mask or a reticle  
onto an object using an exposure apparatus that

includes an optical system, wherein said optical system includes an optical element, and the optical element has a surface to be illuminated by light, and a concave part opposite to the surface; and

5                   developing the exposed object.